Concept Design of Wide Area Monitoring by Ultrasonic Wave and Optical Method

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We consider wide area monitoring systems for detecting leakage of methane gas around the methane hydrate production sites. Concepts of methane gas monitoring systems using ultrasonic wave in the sea and optical method on the sea are studied on the assumption of offshore production test conducted by Research Consortium for Methane Hydrate Resources in Japan(MH21).

Monitoring by ultrasonic wave is the high possible method to the wide area monitoring of methane bubbles in the sea. Many researchers are reported on the surveys of gas leakage from the sea bottom with acoustic sensors. We conducted a literature review on methane plume, such as: 1) methane discharge from submarine mud volcano into the water column offshore of Crimea in Black Sea and offshore of Norway; 2) widespread methane plume in the west area of Sea of Okhotsk; 3) methane plume welling from the pock mark on the bottom offshore Naoetu in Japan Sea. So we checked acoustic sensors used in survey and acoustic images of plume, and confirmed that we can detect methane bubbles discharged from sea bottom by acoustic sensors. We also surveyed other type acoustic sensors such as a side-scan-sonar, an echo sounder and a profiling & imaging sonar, and showed relative merits. Based on the results of these studies, a concept of the wide area monitoring system for the offshore production test organized in Phase-2 of MH21 is showed. An acoustic sensor may be fixed on a cable of a seabed mooring platform. We suppose that sonar used in this test is a profiling & imaging sonar.

On the other hand, we have established the detection technology of methane gas in atmosphere using a laser, too. This technique is in a practical use stage, and it is with the possibility as wide area gas monitoring above the sea. There are many kinds to methane detectors in the vapor phase, but the method detecting a wide area collectively confines a method by the light. Therefore we investigated LIDER System for methane detection around a marine platform. We investigated the system, an ESS system of British Spectrasyne Company and an LIDAR-II system of American LASEN Corporation, etc. We applied the methane detection technology mentioned above and compiled the concept of the wide area methane density monitoring system on the sea. The methane which leaked out from the sea bottom was mixed with seawater, and fading away. Finally it is assumed that methane is discharged in the atmosphere by the wide range of the surface of the sea. Therefore, the monitoring area and detective sensitivity are regarded as more important than the distance resolution. The methane which leaked out from the sea bottom is affected by the ocean current, and it is assumed that it arrives at the remote surface of the sea. Therefore, it is necessary to set the direction of a laser beam in consideration of an ocean current. We also examined the leakage of around the platform with a leakage from the sea bottom, which assumes the problem (a leak from the plumbing) of the facility. In this case, fast responsiveness is demanded in comparison with the distant place. We examine the system which can satisfy two conditions.